Steered Molecular Dynamics Simulations on Human Defensin Crossing Model Bacterial Lipid Membranes

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9/2023-2/2024

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Milestone #1: Become familiar with Unity Linux system, NAMD simulation, and antimicrobial peptides by reading online documents and 1 to 2 related journal papers; launch presentation;

Milestone #2: Set up human beta defensin type 1 to 3 embedding in model Gram-negative bacterial lipid membranes using CHARMM-gui online program; then run NAMD simulations to equilibrate the systems built;

Milestone #3: Run steered MD simulations to pull hBD-1/hBD-2/hBD-3 out of model bacterial lipid membranes;

Milestone #4: Analyze structure, dynamics and free energy profiles from Steered MD simulations; compare results from different defensin simulations, and interpret the results;

Milestone #5: Write a project report, do a presentation based on research findings, wrap up the project, exit interview.

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- Goals
  - Learn background of antimicrobial peptides;
  - Learn basic knowledge of Linux system and simulation;
  - Learn how to set up simulations on protein in solvents using CHARMM-GUI online program;
  - Learn how to run NAMD simulations on UNITY;
  - Learn how to run Steered MD simulations;
  - Learn how to interpret simulation results;

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- Timeframe
  - September 15th, 2023;
  - February 14th, 2024;

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- What I hope to learn
  - Basic knowledge of antimicrobial peptides;
  - Basic knowledge of molecular simulations;
  - Basic knowledge of running Steered MD on UNITY;
- What I have learned
  - Read three papers and wrote three reviews on Human Beta Defensin;
  - Learned basic knowledge of Linux systems;

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- Goals for Next Month
  - Running MD simulations on UNITY;
  - Analyzing MD simulation results;
  - Continue learning about Human Beta Defensin;

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- Help needed (if any)
  - Install VMD on UNITY;
  - Run xmgrace on UNITY;

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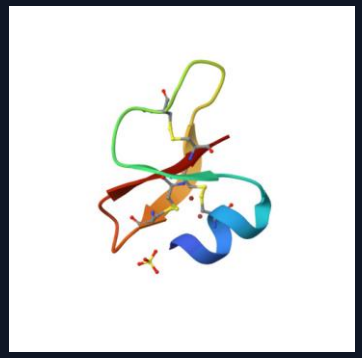
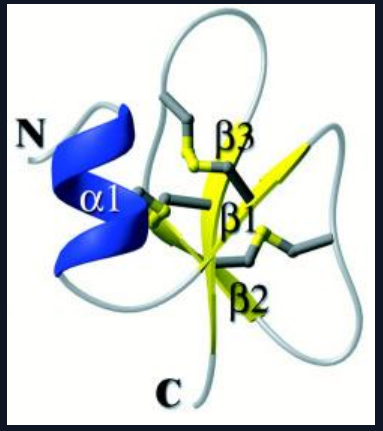
- Human Beta Defensin
  - Peptides that are critical in providing antimicrobial barriers against viruses, fungi, gram-positive/negative bacteria, as well as antibiotic resistant bacteria;
  - Working with 3 defensins: Human Beta Defensin-1, Human Beta Defensin-2, and Human Beta Defensin-3.

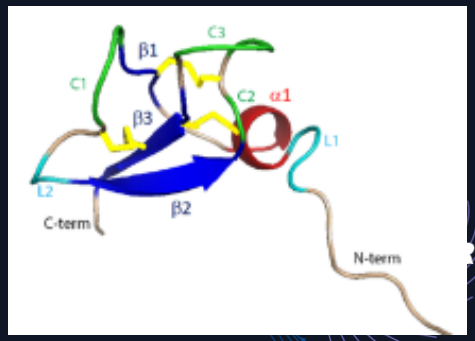
Hoover et al. (2001) J Biol Chem **276**: 39021-39026



Hoover et al. (2000) J. Biol. Chem., 275, 42



Yeasmin et al. (**2018)** *J. Phys. Chem. B, 122* (50), 11883-11894



TEAM

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- Set up hBD-1 monomer, hBD-2 monomer, and hBD-3 monomer in POPC mixed with POPG membrane using CHARMM-GUI online program;
- Running NAMD simulations on hBD-1 monomer, hBD-2 monomer, and hBD-3 monomer in membrane on UNITY

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